U.S. Department of Energy
Energy Efficiency and Renewable Energy
October 2000

FEMP FOCUS

FEDERAL ENERGY MANAGEMENT PROGRAM

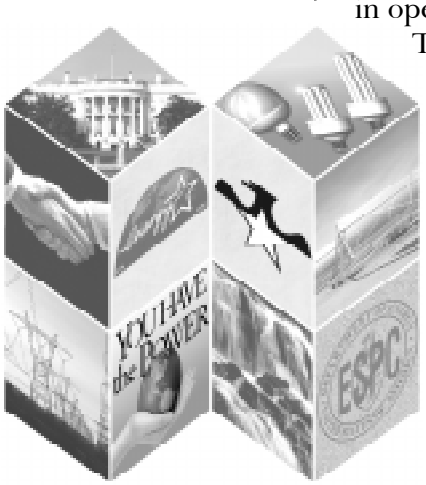
FEMP is Your Partner in Making Projects Happen!

ENERGY STAR® Awarded to ORNL's Buildings Technology Center

The Buildings Technology Center headquarters building at Oak Ridge National Laboratory has achieved the ENERGY STAR® rating, outperforming more than 90 percent of the office buildings across the United States. This building is just one of many Federal buildings that have achieved the rating and is an excellent example of the energy efficiency that can be achieved with just a small investment in technology and close attention to detail to operating the building's energy-consuming systems.

Constructed in 1985, the all-electric, 12,000-square-foot building has about 60 occupants and sizeable electrical loads for heating and air conditioning, personal computers, and office equipment. An energy management system was installed at construction, and the original inefficient lighting was converted to T-8 technology with occupancy sensors in 1994. The HVAC systems, however—a combination of three central and 46 packaged through-the-wall units—are of only low-to-moderate efficiencies (typical of most mid-1980s construction).

The 1994 lighting upgrade reduced total building energy use by 20 percent, but the building's outstanding performance is largely attributable to diligence in operating the building to ensure that energy is not wasted, according to Terry Sharp, a Buildings Technology Center staff member (and the energy engineer who documented the building's performance to earn the ENERGY STAR®). Ensuring that the energy management system works as intended is key to efficient building operation. The system is tied to every heating and cooling system in the building, turning unneeded systems off during unoccupied hours and controlling thermostat settings. It is not extensive control systems, but the care taken to ensure that the building's systems are tightly controlled that makes this building an energy-efficiency model.



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The *FEMP Focus* is published bimonthly by the Federal Energy Management Program of the U.S. Department of Energy/Office of Energy Efficiency and Renewable Energy.

If you are making projects happen at your Federal facility, FEMP would like to hear from you. Please submit project descriptions to Annie Haskins at the address listed below. You will be contacted for additional information if your project is selected to be featured in a future edition of the *FEMP Focus*.

Address mail to:

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FEMP
FEDERAL ENERGY MANAGEMENT PROGRAM

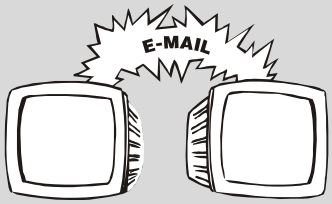
The Director's Column

Beth Shearer, FEMP Director

October is Energy Awareness Month and Federal agencies across the nation are promoting energy awareness to their employees. We have learned that partnerships—among Federal agencies and with the private sector—are among the most effective tools we have to promote energy awareness and efficiency. We've highlighted some of these successful partnerships in this issue of the *FEMP Focus*:

- The U.S. Postal Service (USPS) and Chugach Electric Association, Inc., announced that the nation's largest commercial fuel cell system has begun generating power at the Anchorage Mail Processing Center.
- The U.S. General Services Administration (GSA) has selected Pepco Energy Services, Inc., and Applied Power Corp. to install a 100-kilowatt solar electric system at the Suitland Federal Center in Suitland, MD. Another partner, the Department of Energy, is partially funding the installation, which began providing power to the facility's central cooling plant in September.
- DOE Boston Regional Office personnel recently collaborated with New England General Services Administration building managers in promoting the EPA ENERGY STAR® Program for high-performance buildings in New England.
- A successful "Fed-to-Fed" partnering between the Department of Energy (Bonneville Power Administration and Seattle DOE Regional Office) and the National Park Service (Seattle Office and Lake Mead National Recreation Area) brought together agency and private sector resources to complete the first four of nine planned entrance stations at Lake Mead Recreation Area in Nevada and Arizona.

As a featured event during Energy Awareness Month, FEMP will honor outstanding achievements in energy and water efficiency at the 2000 Federal Energy and Water Management Awards, held on October 12th at Hotel Washington in Washington, DC. This event honors the energy management successes and outstanding accomplishments of energy managers in many Federal agencies. I hope to personally congratulate many of you at the ceremony for your exciting work over the last year.



FEMP Focus by E-mail

FEMP Focus is studying the feasibility of adding an e-mail newsletter subscription that would replace the printed version. By signing up for the e-mail newsletter, your copy of the *Focus* would be sent to your e-mail address and you would no longer receive the printed version. Some of the benefits of switching to an e-mail subscription include more timely delivery and sharper graphics and photos. And because less paper and ink are used in the newsletter's production, you'll help save energy, money, and valuable natural resources.

Currently, about 450 people have signed up to receive the electronic version; however, there needs to be an interest of at least 1,000 people to make a difference in the printing costs. If you are interested in receiving *FEMP Focus* via e-mail, visit the Web site at www.eren.doe.gov/femp/newsevents/whatsnew.html. As always, there is no subscription fee to receive the *Focus*.

Energy Awareness/Partnerships –

Be Energy Smart

FEMP is celebrating Energy Awareness Month with the Department of Energy's theme, "Be Energy Smart." The campaign stresses the importance of conserving energy and making intelligent, clean energy choices.

During Energy Awareness Month and throughout the year, FEMP is asking Federal facilities and others across the nation to promote a greater awareness of the importance of energy resources and the need for greater efficiency in energy use. FEMP encourages agencies to revitalize their commitment to energy efficiency as a significant way to reduce the cost of Government and demonstrate leadership by example. Are you doing all you can to save energy and protect our natural resources? Here are some simple and low-cost ways to reduce your energy bill and promote sustainable energy practices.

- **Buy Energy Efficient Equipment & Appliances–**When buying or replacing computers, refrigerators, copiers, or other large equipment for the home or office, consider purchasing an ENERGY STAR® or Green Lights rated products. Such items use significantly fewer kilowatt hours of electricity per year, which translates into lower utility bills for the user.

- **Install Programmable Thermostats–**These inexpensive devices can optimize your office or home's heating and cooling needs. Programming allows the user to take advantage of peak heating and cooling times and thus reduce electricity use and utility bills. And the user doesn't need to remember to change thermostat settings each time the building is entered or left. (Not appropriate for electric heat pump users, however.)

- **Use Energy-Efficient Lighting Fixtures–**For a small initial investment, compact fluorescent lighting (CFL) provides long-term financial and energy-saving benefits. Consider replacing existing bulbs with CFLs, which are available at all major hardware stores and home centers. Also remember to turn lights off when they are not in use.

- **Install Insulated Window Treatments–** Replace existing window treatments with insulated drapes. For a small cost you get a high return. Insulated drapes keep the interior cool in summer and reduce heat loss in winter.

- **Implement a Ride-Sharing Plan–**To reduce vehicle emissions and the use of fossil fuels, consider starting a commuting program in your office. Many companies have ride-sharing programs as do many local governments and communities. Call the American Council on Transportation at (800) 223-8774 for information on ride sharing in your area.

- **Reduce Hot Water Temperature–**Reducing the temperature on your water heater thermostat can decrease heat loss from the tank. Optimum temperature should be between 100 and 130 degrees.

- **Properly Maintain Heating & Cooling Equipment–**Replacing a dirty air filter will save you money by reducing the amount of electricity needed to run a blower motor. Dust in the filter reduces air flow, making a furnace or air conditioner work harder and longer.

- **Install Water Flow Sensors and Aerators–** These measures reduce the volume of water through pipes and faucets. Easy-to-install, these inexpensive items can save you money by reducing water use as well as saving utility costs on heating hot water.

For more information, please contact Annie Haskins of FEMP at 202-586-4536.

Picatinny and Energy Masters: Teaming Up to Conserve

Executive Order 13123 served as a wake-up call for many Federal facilities. Calling for a 35-percent reduction in energy usage from a 1985 baseline by fiscal year 2010, the mandate was exactly the motivation many military installations needed to initiate energy conservation projects. Picatinny Arsenal, an early pioneer in energy conservation has risen to the challenge of the Army motto, "Conserve Energy with Comfort and Common Sense." To achieve that goal, Picatinny has teamed up with Energy Masters International, a leading energy services company (ESCO).

Currently, Energy Masters is completing implementation of its second Energy Conservation Measure (ECM) at Picatinny. The first two ECMs focused on upgrading lighting systems and heating, ventilation, and air conditioning, and have provided the Arsenal with more than $450,000 in annual savings. Energy Masters is currently developing several follow-up ECMs that should result in additional annual savings of more than $400,000 and enable the Arsenal to comply with Executive Order 13123 by 2010.

The upgrades performed at Picatinny are made possible through an Energy Savings Performance Contract (ESPC). The cost savings created by a reduction in energy usage are used to pay for upgrades and improvements over a financed contract term. During that term, energy savings are guaranteed by the ESCO, in this case, Energy Masters. "ESPC revitalizes the energy systems infrastructure," said Doug Karnuth, Senior Project Manager at Energy Masters. "The partnership judiciously leverages resources to provide an efficient, cost-effective energy management program that saves tax dollars."

While the obvious benefit of these capital improvements is energy reduction and the resulting monetary savings, an increase in occupant comfort adds significant value to the project. Picatinny occupants now have better indoor air quality, more uniform room temperatures, and improved overall living conditions.

A spokesperson for Picatinny, Ron Kraus, Director of Public Works, notes these additional advantages of ESPC: "Our partnership with Energy Masters allows us to improve the quality of life for workers and residents, operate our energy systems more efficiently, and meet the Arsenal's overall mission. At the completion of this project, we will have more comfortable settings for residents and workers, increased trust in the reliability of our energy system, reduced maintenance costs, and the elimination of long periods of time for heating and cooling switchovers."

The Army Materiel Command (AMC) has been very supportive of Picatinny's progressive approach to saving energy. "Picatinny's tremendous leadership in its Public Works Department is striving to improve the Arsenal's infrastructure and quality of life for the employees," said Dick Faith, AMC ESPC Program Engineer. "Picatinny is setting a standard through ESPC that Army facilities must strive to emulate." Faith additionally noted that the Arsenal was selected as the AMC winner in the "Organization" category and received the *Federal Energy and Water Management Award* for fiscal year 1999. Picatinny also placed in the final five in the *Secretary of the Army Energy Award* and was selected as the Department of Energy winner in the "Army Organization" category.

Energy Masters is a nationally accredited industry leader, providing energy management assistance to military installations nationwide. The company is currently developing and/or implementing projects at more than 20 Federal facilities.

For more information, please contact Rich Sloboda, Energy Coordinator, Picatinny Arsenal at 973-724-7542, or rsloboda@pica.army.mil.

Improving Federal Steam System Efficiency

Department of Energy's Office of Industrial Technologies and the Alliance to Save Energy, in concert with FEMP, offer a free E-mail newsletter on resources for steam system management. *Steaming Ahead,* published bi-monthly, offers tip sheets and case studies, along with a host of technical resources developed for improved steam system management. Steam system energy management workshops are conducted periodically throughout the country.

Proper operation and maintenance of steam systems lowers operating costs and improves plant reliability and environmental performance. More than 50 percent of the fuel used by U.S. industrial-manufacturing plants is used to generate steam, at an approximate cost of $18 billion (1997 dollars). The Alliance to Save Energy estimates that a typical plant can improve the efficiency of its steam system by 20 to 30 percent.

The DOE Office of Industrial Technology's Best Practices program assists industry in adopting near-term, energy-efficient technologies and practices through voluntary, technical assistance programs. Best Practices covers motors, compressed air, steam, and combined heat and power systems.

Federal energy and plant managers can browse the Best Practices Web site and/or contact the Industries of the Future Clearinghouse to receive limited technical assistance and information on training opportunities, technical tools, references and standards, and notices of workshops with peer networking opportunities. For technical resources, call the Clearinghouse 800-862-2086 and/or browse the Web site at www.oit.doe.gov/bestpractices/steam. To subscribe to Steaming Ahead or if you have any questions, send an e-mail to djaber@ase.org with the subject header "Subscribe to Steaming Ahead" and your e-mail address in the text of the message.

Agencies Partner to Build Solar Entrance Stations

A successful "Fed-to-Fed" partnering between the Department of Energy (Bonneville Power Administration and Seattle DOE Regional Office) and the National Park Service (Seattle Office and Lake Mead National Recreation Area (NRA)) brought together agency and private sector resources to complete the first four of nine planned entrance stations at Lake Mead NRA in Nevada and Arizona.

This project is the most ambitious effort attempted to date under Interagency Agreements that are the foundation of the Green Energy Parks Program. NPS and DOE incorporated an advanced mix of solar technology, energy efficiency, and other sustainable building practices. An estimated 5 million visitors each year will pass by these solar powered entrance stations.

This National Park Service project is a showcase for sustainability. The entrance stations include an integrated solar roof and shade structure (two of the stations operate independent of the power grid), energy-efficient HVAC and lighting systems, alternative fuel backup generation, low flow water fixtures, and xeriscaping (landscaping). Fuel cells

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Integrated solar roof and shade structure, Las Vegas Boulevard station.

FEMP Partners with the DOE State Energy Program

DOE's State Energy Program (SEP) provides funding to states to design and carry out their own energy efficiency and renewable energy programs. The results from this program are directly linked to a large number of diverse and innovative projects in local communities across the United States and its territories. The outcome of this DOE funding is a rapid and inventive deployment of new energy efficiency and renewable energy technologies.

The State Energy Program has competitively selected 148 projects in 47 states, two territories, and the District of Columbia for fiscal year 2000 funding under the program's Special Projects component. More than $16 million is being provided by the Department's Office of Energy Efficiency and Renewable Energy's End-Use Sector programs. The Special Projects awards provide specialized funding in addition to annual "formula" grants the State Energy Program awards to each State Energy Office. DOE made the awards in July to all States except Delaware, North Carolina, and South Dakota, which did not submit applications. The territories slated to receive awards are Puerto Rico and American Samoa. More detailed information on the SEP can be found at www.eren.doe.gov/buildings/state_energy/winners00.html.

FEMP provides funding to states for participating in Special Projects aimed at increasing the energy efficiency of government facilities. Where possible, SEP activities focus on state government facilities. In the first four years of the SEP Program, this funding has totaled $2.7 million.

Through SEP Special Projects funding, FEMP conducts three types of activities:

- Project financing,
- Technical guidance, and
- Project planning and assistance.

Wherever possible, FEMP brings technical innovation to the government sector. For example, FEMP is providing technical support to a PV project at Dangling Rope Marina at Lake Powell in Utah that, when complete, will be the largest PV-diesel hybrid electricity system in the country. A number of partners, including FEMP, SEP, and the state of Utah, are playing a role in this project. The Dangling Rope Marina is a good example of implementation of FEMP projects in the states.

National Park Service living quarters at Dangling Rope Marina at Lake Powell, Utah. All electricity is provided by the PV panels seen in the foreground. Photo by Warren Gretz.

Sunset at Dangling Rope Marina, Lake Powell, Utah: The Dangling Rope marina PV / hybrid power system, designed and installed by Applied Power Corporation is the largest solar energy system in the National Park Service and is expected to save more than $2.3 million in fuel and maintenance costs over a 20-year period.

GSA Installs Large Solar Electric System at Federal Center

The U.S. General Services Administration (GSA) has selected Pepco Energy Services, Inc., and Applied Power Corp. to install a 100-kilowatt solar electric system at the Suitland Federal Center in Suitland, MD. The Department of Energy is partially funding the installation, which began providing power to the facility's central cooling plant in September. Ground has already been broken for the system, which will include 2,800 thin-film photovoltaic modules. The project will demonstrate to government agencies and other organizations the short construction time needed in developing solar power stations.

Pepco Energy Services will serve as the general contractor and project manager of the system while Applied Power Corp. will design, build, and install the equipment. The General Services Administration funded the generation station to support the Planet GSA program, the President's Million Solar Roofs Initiative, and the goals of Executive Order 13123. "This system demonstrates the General Services Administration's commitment to a cleaner tomorrow," said GSA's Anthony Costa, Assistant Regional Administrator for the Public Buildings Service in the National Capital Region. "The President has set a goal for the Federal government of 2,000 solar energy installations by the end of this year, and the GSA is helping to make that goal a reality."

The project will showcase how quickly and easily amorphous silicon technology can meet the energy needs of many different types of commercial and industrial facilities. Unlike polycrystalline silicon technology, which has been in use for more than two decades, amorphous silicon technology is an advance cell material that performs better under high ambient temperatures and costs less to manufacture.

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USPS Installs One-Megawatt Fuel Cell System in Alaska

The U.S. Postal Service (USPS) and Alaska's largest electric utility have delivered another stamp of approval for energy efficiency and protecting the environment. USPS and Alaska's largest electric utility announced August 9, 2000, that the nation's largest commercial fuel cell system began generating power at the Anchorage Mail Processing Center. The one-megawatt system consists of five fuel cells manufactured by International Fuel Cells. The Chugach Electric Association, Inc., installed and will operate the system for the USPS.

In a ribbon-cutting ceremony at the Anchorage Mail Processing Center, U.S. Senator Ted Stevens and U.S. Postmaster General Bill Henderson inaugurated service of a one-megawatt fuel cell system now generating power at the postal facility.

Five fuel cells, connected in parallel to produce one megawatt of electricity, now are the primary source of power for the Anchorage facility, located adjacent to Ted Stevens Anchorage International Airport. The fuel cells are part of the local electric utility's grid—operating in parallel with the grid, dispatched from the utility's central system dispatch center. Excess power from the fuel cells is fed into the Chugach electric grid.

The fuel cells that make up the system were developed and manufactured by International Fuel Cells (IFC), South Windsor, CT, a subsidiary of United Technologies Corporation.

Congratulating those involved with the fuel cell project, Postmaster General Henderson said: "The mission of the Postal Service is to provide cost-effective, high quality, and consistent mail service to our customers, in all kinds of weather and in all types of conditions. Clearly, this fuel cell

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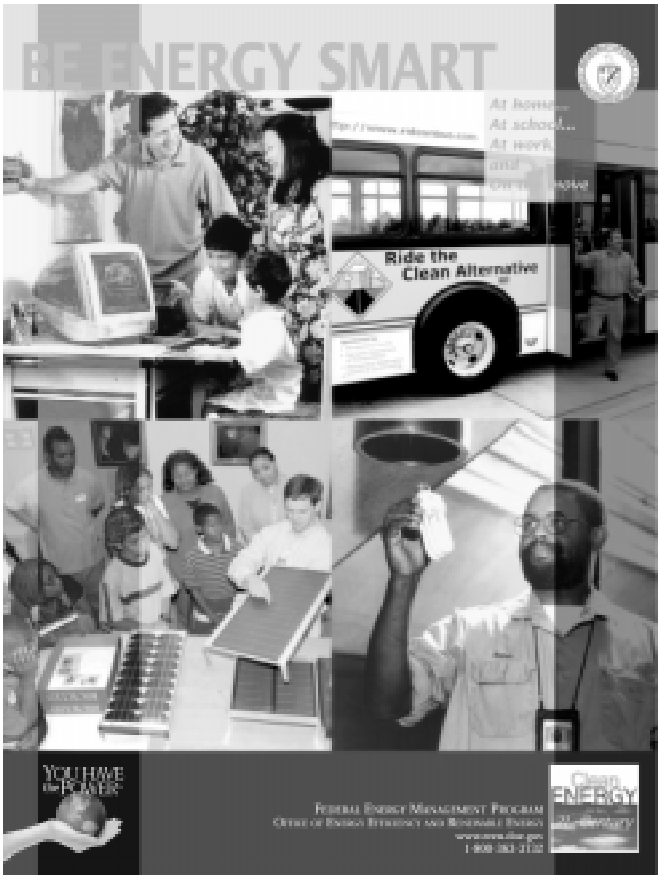
Make Your Federal Facility a "Good Neighbor"

Two Federal laboratories in Livermore, CA, are among the major power users that are voluntarily curbing energy consumption during peak demands to reduce the drain on the state's power supply. Lawrence Livermore Laboratory and Sandia National Laboratories in Livermore ask employees to turn off unnecessary electrical equipment when the labs receive alerts from the California Independent System Operator (ISO), a non-profit corporation that manages the flow of most power in the state. The ISO has issued about two dozen power alerts during hot weather this year to ask agencies and businesses to reduce power usage.

There are three stages of alert issued by the ISO. A stage-one alert, issued when electrical operating reserves fall below 7 percent, calls upon power users to voluntarily reduce use of unnecessary electrical equipment. A stage-two alert, declared when reserves fall below 5 percent, is a stronger request for voluntary reduction. And at stage three, when reserve power is certain to drop below 1.5 percent, outages may be imminent. There have been about 15 stage-two alerts since May 2000, though the ISO has not yet called for a stage-three alert. Livermore Lab has reduced energy use during the alerts by about 7-10 percent, lab officials said. "While under no mandatory order to do this, the lab is being a 'good neighbor,'" according to a lab statement.

The peak use period at the lab typically occurs between 1 p.m. and 3 p.m. during the months of July and August. The early half of the week tends to be busier, in terms of power use, than the latter half. At Sandia Lab in Livermore, the peak power use is typically between 2:30-3 p.m. Both labs have power generators that allow them to continue operating during outages. Typically, the average peak in power use at the lab during summer of 1999 was 49,457 kilowatts, or 49.5 megawatts. A megawatt is 1 million watts. The average power use during weekdays in July of this year was 44.4 megawatts. Sandia Lab had a peak demand of 5.8 megawatts in July, down from a peak demand of 6.8 megawatts in July 1999. And power use at the lab could rise about 33 megawatts over the next several years with the planned addition of a supercomputing center and the National Ignition Facility laser project. On June 14, an area that includes Livermore, Pleasanton, Dublin and San Ramon hit a record in peak power use, reaching 496 megawatts, said Tom Collins, a spokesman for Pacific Gas and Electric Co (PG&E). The entire Bay Area, including San Francisco, San Jose, and the East Bay, can consume about 8,800 megawatts during peak periods. By comparison, the statewide demand has reached about 44,000 megawatts during peak periods.

For more information, please contact Mark Clark, DOE Oakland Operations Office at 510-637-1654.



EAM Poster available at 1-800-363-3732.

HHS Energy Program Highlights

During the past five years, the U.S. Department of Health and Human Services (HHS) Energy Program has evolved into a multi-faceted campaign aimed at achieving Federal energy mandates, providing technical assistance, disseminating information on Federal and private energy and water programs, and promoting energy awareness to facilities nationwide. Since the program's inception, HHS has saved $7.8 million dollars in energy costs due to the implementation of energy efficiency projects and the increase in energy awareness. They have always believed that emphasis should be placed on employee awareness activities, but that in order to change energy and water conservation habits at the workplace, employees must practice them at home, too. Therefore, the energy awareness aspects of the HHS Energy Program target the office as well as the home environment. This philosophy can be seen in the various awareness tools used in the program and the topics highlighted below.

The HHS Energy Program sponsors an annual energy seminar that highlights successful energy and water efficiency techniques and projects, with the ultimate goal of increasing energy awareness among the HHS energy management personnel. HHS facility managers, engineers, and energy managers from around the nation attend the seminars to learn the latest on Federal energy management programs, new project financing strategies, successful projects and initiatives, and innovative energy and water conservation products. HHS also sponsors an Energy and Water Management Awards ceremony attended by senior FEMP and HHS officials who help celebrate the outstanding achievements of HHS energy personnel in energy and water efficiency.

The *HHS Energy News* newsletter describes energy and water efficiency activities occurring throughout HHS facilities and provides information on products or programs to conserve energy and water both at the workplace and home. Each edition highlights an HHS Energy Leader and includes a question and answer column on seasonal or current event issues. The newsletter also offers a feedback form that many employees use to provide additional ideas and ask questions on energy and water issues. Complementing the *HHS Energy News*, is the *HHS Energy Manager's News*, a technical newsletter targeted at energy and facility managers.

Each year, HHS sponsors major awareness events nationwide for Earth Day and Energy Awareness Month. The reaction to these events has been extremely positive and participation grows stronger every year. Several events have showcased energy, environmental, and water conservation products and programs from local vendors, utility companies, and outreach organizations. Special events, such as an Earth Day Maze and a Scavenger Hunt that challenged employees to become directly involved in learning about energy and the environment, have been held.

During Energy Awareness Month, the HHS Energy Officer and Operating Division energy coordinators complete annual nighttime energy audits. If lights or equipment have been left on, a ticket is left reminding the employee to turn the equipment off when leaving for the day. Awards stickers are provided to those employees who have turned everything off. Conservation tips pamphlets, magnets, and *You Have the Power* campaign materials are also left at the employees' workstations. The audits have been highly successful and annual audits have shown dramatic improvements in the conservation habits of HHS employees.

HHS has developed effective agency-specific awareness handouts to be used in conjunction with the *You Have the Power* campaign materials. Unique posters, flyers, stress balls, stickers, magnets, pens, and coffee mugs have been designed to increase exposure of and interest in the HHS Energy Program.

For more information, please contact Diana Hirshfeld, HHS Energy Services Contractor at 703-620-4330.

The Greening of the Corps of Engineers Army Reserve Training Center and Maintenance Shop

In Toledo, OH, the U.S. Army Corps of Engineers Army Reserve Training Center and Maintenance Shop provides a dramatic demonstration of how Federal facilities managers can bring this idea to life. The Center, a Federal Energy Saver Showcase winner, is an example of integrated energy efficiency design for a building type that is, by nature, difficult to make energy efficient. The training center is a 41,790 square foot facility that includes a 29,304 square foot open-bay vehicle operation and maintenance support facility.

The building's non-traditional but "off-the-shelf" heating and cooling systems are two of several key elements contributing to the exemplary energy efficiency of the facility. Notably, the area is heated by an hydronic radiant floor system circulating 120°F water in plastic pipes through the concrete flooring. Much of the system's efficiency derives from the use of 120°F rather than 180°F water, customary with traditional floor-heating systems.

In addition, cooling for the training center is provided by a thermal energy storage system. The equipment makes ice at night when electric rates are low, and stores it in tanks charged by a 60-ton helical screw chiller. The stored ice is then used for cooling during the day.

The design and equipment selections save the Center $16,000 per year on electric bills, compared to traditional choices, with no sacrifice in comfort or utility. The design also resulted in more than $11,000 in rebates from the local electric utility. The Center has about 10 full-time workers during the week, and up to 450 reservists on weekends. This results in large variations in energy loads and use, which the Center accommodates well.

This kind of energy-centric design and engineering is just one example of how Federal facilities managers everywhere can meet the expectations outlined in Executive Order 13123. Those managers who have responded vigorously to this order, as they have in Toledo, understand that energy conservation is about more than saving watts and dollars.

These managers understand that this work, the work of efficiency and environmental sustainability, is critical to the creation of better work environments and communities. They understand that by rethinking the old ways of managing facilities, using environmentally preferable, high efficiency products, and by upgrading the energy efficiency of these buildings, they create healthier and more productive working environments.

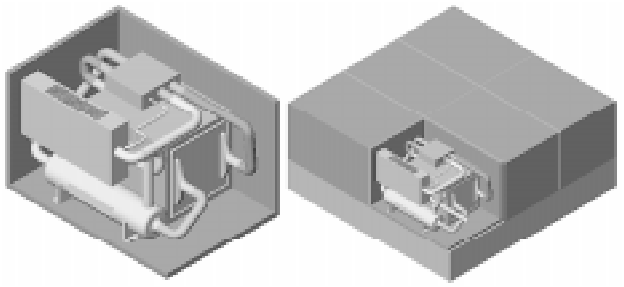
They know in Toledo, and in Federal facilities in many other places, that by building sustainably for energy efficiency, we create healthy environments that respond to today's needs without imposing additional costs on future users.

For more information, contact Michael Segal at msegal@cadmusgroup.com.

New Technology/Partnerships

Two DOE Labs Facilitate Fuel Cell Research

The goal of a new industry-government-university consortium led by two Department of Energy (DOE) labs—Industries of the Future Industries of the Future Pacific Northwest National Laboratory and the National Energy Technology Laboratory–is to have clean, affordable, and highly efficient solid oxide fuel cells on the market in 10 years. Called the Solid-State Energy Conversion Alliance, SECA's aim is to develop a fuel cell that meets the diverse power needs of multiple markets and runs on readily available fossil fuels, such as natural gas, gasoline and military fuels. DOE funding for the consortium is projected to be $350 million over the next 10 years.



A proposed five-kilowatt solid oxide fuel cell module (left) will be used to meet smaller energy needs or be combined with other identical modules (right) to handle larger power requirements.

Members of SECA believe they can reduce fuel cell costs through mass production of a versatile, five-kilowatt fuel cell module. In the future, the module is envisioned to meet energy needs in a range of markets, including residential, military and transportation. Nearer-term applications include auxiliary power to operate heaters, air conditioners, and other accessories in autos and semi trucks, and complex electronics on military equipment. Developers also foresee modules that are "stackable," so units can be combined to accommodate larger power needs.

For more information, contact Gary McVay, PNNL, 509-372-3762.

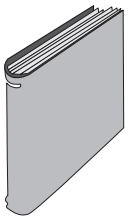
Upcoming Issues of the *FEMP Focus*

Special Issue
Executive Order 13123 Guidance

November/December 2000
Special Federal Energy and Water Management Awards Issue

January/February 2001
Renewable Energy

Utility Management and Planning—



Utilities Management Approaches at Fort Huachuca

How do you manage the utilities for an Army Fort covering 114 square miles with 8 million square feet of facilities? Very carefully!

When the Resources Management Division Chief retired in January 1995, instead of filling his position, the Fort Huachuca energy management team split his duties amongst those left including the responsibilities of the Utilities Sales (and Purchases) Officer. The year prior (fiscal year 1994) more than $7.1 million was spent for 105,000 megawatt-hours of electricity and more than $2.1 million for 3.5 million therms of natural gas. Electric peak demand set new records of 21.3 megawatts in July 1994 and annual load factor was a less than stellar 56 percent. After checking electric rates against other Army installations, Fort Huachuca was the fifth highest in the continental United States. Natural gas rates were in the top 25 percent for cost. That combined annual electric and natural gas bill of $9.3 million would present both a challenge and opportunity.

Fort Huachuca's energy management team proposed four ways to reduce the utility bill. The first way was to reduce consumption (conservation). The second way was to switch between energy sources (given the opportunity) which would prove more economical. The third was to replace the energy purchased self-generated with renewable energy. And finally, they negotiated a reduction in rates. The entire task was made more difficult because at this time Fort Huachuca was adding new energy intensive buildings (Intelligence training with air-conditioning) while demolishing less energy intensive buildings (World War II wood with evaporative cooling).

The utilities management division was already implementing conservation projects, and continued to do lighting upgrades, motor replacements, more efficient heating and cooling system replacements, building insulation and controls replacements and installations. When the direct funding dried up in 1996, management switched to a basewide energy savings performance contract to get the work done. Another opportunity was the replacement of the entire natural gas system from 1994 to 2000. The results were that the electric use peaked out at 108,000 megawatt-hours in FY 1996, and it was down to 97,000 megawatt-hours in FY 1999. The peak electrical demand was reduced to 16.6 megawatts in 1999 and the annual load factor was improved to 66 percent in fiscal year 1999. The natural gas use peaked at 5.2 megatherms in FY1995, but was down to 3.8 megatherms in FY 1999.

Various methods were undertaken related to switching energy sources. In 1995 and 1996, management changed from electric chillers to two-stage absorption chillers in the hospital (two steam-fired from natural gas boilers) and in one wing of Greely Hall (one direct-fired natural gas). In 1997, management started to cogenerate from a 200-kilowatt fuel cell that uses natural gas. The fuel switching and energy source substitution saved about $250,000 annually on the total utility bill. Unfortunately, with the current high price of natural gas, the savings have been greatly reduced and with the failure of the direct-fired natural gas two-stage absorption chiller at Greely Hall, it will soon be replaced with an electric chiller.

Fort Huachuca has used various solar systems to replace conventional energy sources.

- From 1994 to 2000, management installed 17 non-grid-connected photovoltaic (PV) powered parking lot lights. In 1992, management installed six non-grid-connected PV marquee signs. Additionally, management installed an 18-kilowatt single phase grid-connected PV system.
- In 1997, they repaired a 5-kilowatt three-phase grid-connected PV system and upgraded the

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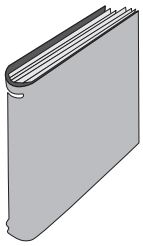

UTILITIES MANAGEMENT AT FORT HUACHUCA
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18-kilowatt system to 30 kilowatts, and in 1998 they installed 2.4 kilowatt and 4.8 kilowatt peaking (both West facing) single phase grid-connected PV systems.

- In 1996, they installed a 7.5 kilowatt dish/Stirling solar thermal electric generator. In 1998, they upgraded that system to 10 kilowatts with a new engine. In 2000, they further upgraded that system with new mirrors.
- In 1996, they installed three new solar domestic hot water systems (384 SF active system for a barracks and two passive systems for housing) and moved and refurbished a small two panel active system (64 SF). In 1999, they installed four passive solar domestic hot water units in housing as part of a comparison test.
- In 1997, they installed daylighting on one of the main airfield hangars (30 6' x 6' units). In 1998, they had daylighting installed in 60 housing unit replacements (120 total).

By the end of this calendar year 27 more buildings will have daylighting installed. Construction is now underway to install two 2300 SF Solarwalls on the two main airfield hangars.

The last initiative was to negotiate reduced rates. After years of work, the Fort Huachuca energy management team was able to avoid tariff for natural gas and signed a ten year anti-bypass contract in August 1996. This contract had the effect of reducing natural gas rate from 45 cents per therm in 1995 to 37 cents a therm in 1997. In 1999, the natural gas average rate was 35 cents per therm while the tariff was up to 54 cents a therm. To get these lower prices they used contracts through the Defense Energy Support Center and bought natural gas either on index or used futures for risk management. Electricity has been a different story. They have been able to do very little to significantly reduce rates. Every option they suggested was unacceptable to the electric utility (interruptible, base load generation, peaking generation, time of use rates, etc.). The energy management team is now considering a long term energy purchase contract from wind turbines that would be installed in the Fort. This could reduce the electric rates to as low as 5 cents per kilowatt-hour, with a maximum annual savings of $1.6 million.

Another area of utilities management is water. Fort Huachuca pumps, treats, and distributes their own water. While these costs are internal, half the cost of water is in the electricity to pump it. In calendar year 1993, water use was 987 million gallons of water. The energy management decided to make some changes. In the spring of 1994, they modified the irrigation policy for family housing and greatly reduced the amount of residential watering allowed. In 1994, the water use dropped to 837 million gallons. In 1996, they put further refinements on their watering policy and also completed their first installation of a waterless urinal. In 1996, water use fell to 768 million gallons. By 1999, Fort Huachuca had installed 275 waterless urinals and was starting to install 1.5 gallons-per-minute showerheads. In 1999, water use had dropped to 617 million gallons. In the six years from 1993 to 1999, water use has been reduced by 370 millions gallons per year, or 37 percent. For the first six months of 2000, the comparison versus 1999 shows a 6.5 percent decrease.

The bottom line result: In fiscal year 1996 the total natural gas and electric bill peaked at $9.5 million. In fiscal year 1999, the total natural gas and electric bill was $7.8 million. That is a $1.7 million dollar decrease over three years (18 percent).

Fort Huachuca has received numerous Federal Energy and Water Management Awards in the past for their achievements in energy and water efficiency. Once again, the successes and outstanding accomplishments of their energy managers have been honored at this year's awards ceremony in Washington, DC.

For more information, contact William Stein, U.S. Army, at 520-533-1861 or william.stein@huachuca-emh1.amy.mil.

Your Alternative Financing Questions Answered

I am considering using a DOE Super ESPC, but am concerned that I do not fully understand all the measurement and verification issues. Where can I get help with this?

FEMP has recently completed the development of a new set of measurement and verification (M&V) tools including:

- FEMP M&V Guidelines Version 2.2. Additions in this new version include added water M&V methods, added new construction M&V methods, M&V for operations and maintenance, M&V for cogeneration, and M&V for renewable energy projects.
- Initial and final proposal M&V checklists. This shows what should be included in both of these important documents.
- An M&V responsibility matrix. This lays out who is responsible for what under three categories: financial, operational, and performance.

Also under development are the following:

- Sample M&V plans. These will provide example formats for lighting, energy management and control system, and chiller projects.
- A delivery order case study. This will describe an example delivery order from project development through first year M&V.
- Stipulation guidelines. This will provide a good definition of stipulation and provide procedure for selecting parameters to stipulate.

All the completed resources are available on the Web. You can find version 2.2 of FEMP's M&V Guidelines at www.eren.doe.gov/femp/financing/measguide.html, and you can find the other new tools at Lawrence Berkeley National Laboratory's M&V Web site: http://ateam.lbl.gov/mv.

*What questions do **you** need answered? FEMP wants to provide the most useful information possible, but we need your help to achieve this! Please submit your questions **via e-mail** to Tatiana Muessel, at: tatiana.muessel@ee.doe.gov.*

Energy Management Services Now Available on GSA Schedule

The General Services Administration's Management Services Center has developed a new Federal Supply Schedule to assist Federal agencies obtain energy services. The Federal Supply Schedules Program was developed under FAR 8.4 to provide the Federal community with contracted vendors in related product and service groupings to expedite the acquisition process for products or services.

The Energy Management Services Schedule, 871 II, has awarded contractors available and ready to receive task orders from Federal agencies. By ordering from this schedule instead of awarding a new contract, agencies can save months of time, while obtaining the lowest price and best value for the taxpayer. Under this schedule, agencies will be able to find contractors to do energy auditing, metering and billing, and to purchase natural gas, electricity and renewable energy. The goal is to provide "one stop shopping" for all agencies to more easily meet their energy efficiency goals. More information about the schedules program, and ordering procedures is available online at **www.fss.gsa.gov/schedules.**

The special item categories for this schedule are:

871-200 - Energy Management Program Support

- Energy planning and strategies,
- Energy choice analysis,
- Risk management,
- Metering services,
- Billing and management oversight, and
- Preparing statements of work.

871-201 - Energy Audit Services

- Energy audits,
- Resource efficiency management,
- Use of alternative energy sources, and
- Building commissioning services.

871-203 - Managing the Procuremen and Use of Natural Gas

- Supplying natural gas to deregulated markets, and
- Emergency power sources for backup power.

871-204 - Managing the Procurement and Use of Electricity

- Supplying electricity to deregulated markets, and
- Emergency power sources for backup power.

871-205 - Managing the Procurement and Use of Energy From Renewable Sources

- Supplying electricity to deregulated markets from renewable power (i.e. wind, geothermal, biomass),
- Supplying natural gas to deregulated markets from renewable sources (i.e. biomass), and
- Emergency power sources for backup power.

871-299 - Introduction of New Services

For additional information, contact Patricia Finch, Management Services Center, GSA, at 253-931-7073 or visit www.northwest.gsa.gov/fss/services/msc.htm.

GSA INSTALLS LARGE SOLAR ELECTRIC SYSTEM AT FEDERAL CENTER

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The PV system installation is supported in part by funding from the Department of Energy through an award from the Utility Photovoltaic Group's TEAM-UP program. Pepco Energy Services provides commercial, institutional, and government customers a complete suite of integrated energy management solutions including electricity and natural gas; energy assessments; energy information systems; fuel management services; heating, ventilation and air conditioning system; lighting project financing; and energy operations and maintenance services.

For more information, contact Gary Caruso, GSA, at 202-260-4227 or visit http://ncr.gsa.gov/.

New Tools from FEMP's GHP Core Team

The FEMP Geothermal Heat Pump (GHP) Core Team works to make the energy efficiency benefits of GHP technology more accessible to Federal agencies by providing technical assistance, tools, and other resources, as part of FEMP's GHP Technology-Specific Program. The Core Team aims to bring GHP technology into the mainstream and make it just as easy to design, install, and maintain as other heating, ventilating, and air-conditioning (HVAC) technologies. The Core Team uses data and experience gained from best-practice GHP projects to resolve technical problems, prove techniques, and produce the kinds of standard tools and guides already available for other HVAC technologies.

The GHP core team has produced several new publications and design tools (described below) that are now available at the FEMP Web site at www.eren.doe.gov/femp/financing/ghpresources.html.

Determining Thermal Properties of Soil and Rock Formations for GHP Design

Determining the thermal properties of the local soil and rock formations is a key step in optimal design of GHP systems that use vertical ground heat exchangers. The thermal conductivity of the ground is the primary determinant of how much area for heat exchange is needed for sufficient heating and cooling capacity—that is, the overall vertical bore length and quantities of pipe, grout, and other materials required. The finished vertical ground heat exchangers account for a large percentage of the total cost of many GHP systems, so designers need highly reliable thermal properties data to design cost-effective systems guaranteed to have sufficient capacity.

Identification of the soil and rock layers at the construction site yields insufficient information for large project design, because handbooks list the thermal properties of each material as a broad range of values. The standard method of determining thermal properties is to install one or more vertical ground heat exchangers on the construction site, impose a known thermal load, and run tests for a number of hours. The GHP Core Team has developed a method for analyzing the data from these tests that uses a parameter-estimation technique. This method can accurately and reliably determine average (top to bottom) formation thermal properties from tests of shorter duration than were required in the past, and test results are not affected by variations in heat input or power spikes during testing, which has been a persistent problem. The method, which has been laboratory- and field-tested, is described in a report, "New Method to Determine the Thermal Properties of Soil/Rock Formations from In Situ Field Tests." The report also includes a tutorial for The Geothermal Properties Measurement Model, a computer program based on the method. The report and the computer program are available for download from the FEMP Web site.

Generic Guide Specifications for GHP Installation

The GHP Core Team also developed generic guide specifications to assist Federal agency engineers in the preparation of construction specifications for GHP projects. These specifications are in the industry-standard Construction Specification Institute format, cover the most popular members of the family of GHP systems, and are applicable to any kind of Federal sector GHP project.

Life Cycle Cost Analysis

Life cycle cost is a primary standard of value at Federal facilities, and is treated in the report, "Geothermal Heat Pumps in K-12 Schools: A Case Study of the Lincoln, Nebraska, Schools." The report documents ORNL's study of four identical, newly built elementary schools with GHP systems and other schools with conventional HVAC systems. One objective of the study was to determine the life cycle costs of the GHP systems and compare them to the costs of other HVAC

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Energy Metering Workshop

The Federal Energy Management Program, DOE's Atlanta Regional Office and the Alliance to Save Energy will cosponsor a free, one-day workshop to be held October 24, 8:30 am - 4:15 pm, prior to the 2000 World Energy Engineering Congress (WEEC) in Atlanta.

All Federal Energy Managers and Federal Procurement and Contract Staff involved with ESPC contracting are invited to attend.

The workshop will provide a non-technical overview of cost-effective, practical uses of energy data, energy savings from building commissioning, and new guidance for monitoring and verification of ESPC projects. Participants will increase knowledge of the multiple uses and benefits of collecting and analyzing measured building energy data.

For more information, E-mail Malcolm Verdict at mverdict@ase.org or call 202-530-2213.

FEMP Training Reminders

Oct. 24	Atlanta, GA *FEMP Energy Metering Workshop* (In conjunction with WEEC) 202-857-0666
Oct. 24-25	Denver, CO *Life-Cycle Costing* 509-372-4368
Oct. 25-27	Atlanta, GA *World Energy Engineering Congress* FEMP Symposia 703-243-8343
Nov. 15-17	Golden, CO *FEMPLights (advanced)* 916-962-7001
Jan. (TBD)	Golden, CO *Electric Utility Restructuring and Utility Project Financing* 703-243-8343
Feb. 5-6	Honolulu, HI *Operations and Maintenance Management* 509-372-4368

Energy 2001

New Horizons - Solutions for the 21st Century
Kansas City, Missouri
June 4-6, 2001

Visit our Web site:
www.energy2001.ee.doe.gov

An Energy Efficiency Workshop and Exposition

- Alternative Financing
- Basics of Energy Management
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- Relationship Building
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- Strategies for Energy Projects
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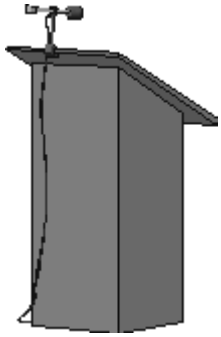

Energy 2000: Expanding Horizons and Staying Green

Pittsburgh, PA was the site of Energy 2000, the energy efficiency workshop and exposition sponsored by the Federal Energy Management Program, Department of Defense, and General Services Administration. Held August 21-23, the conference provided participants with opportunities to explore such topics as strategies for energy projects, selling energy projects, and alternative financing. The conference also had panel discussions, an exhibit hall showcasing energy technologies, and chances for relationship building.

Participants gained a solid foundation of information from in-depth sessions presented by experienced energy professionals. Participants learned first-hand during interactive workshops what works, what doesn't, and how facilities can be more efficient. Attendees were educated on the latest laws, requirements, directives, and regulations and how they should be applied to their organization. They compared and evaluated the latest energy tools, techniques, and services available to increase efficiency and streamline energy programs. The latest technologies were available from energy efficiency, renewable energy and water conservation suppliers at the Energy 2000 Exposition, and exhibitors were anxious to help analyze and resolve current and future energy efficiency challenges. Many of the presentations given at Energy 2000 are now available online at www.energy2000.ee.doe.gov/tracks.htm.

In keeping with the efficiency and conservation focus of the conference, organizers made every attempt to make Energy 2000 a "green" meeting. In addition to minimizing printed materials by targeting the mailings, organizers encouraged paperless, online registration at the FEMP Web site. Food service suppliers were requested to keep polystyrene materials to an absolute minimum, and to use china and glassware when feasible. Brochures and other materials used vegetable-based or soy ink and recycled paper. The planning committee also worked closely with area hotels to encourage environmental and energy policies regarding linens and towels, thereby reducing water and energy usage. These policies and practices have proved popular with attendees and will continue to be employed at future conferences.

Don't forget to mark your calendars for the next FEMP conference, "Energy 2001: New Horizons - Solutions for the 21st Century." The conference will be held June 4-6, 2001 at the Hyatt Regency Crown Center in Kansas City, MO. Visit the Web site at www.energy2001.ee.doe.gov/ for more information.

Ted Collins, FEMP, and Curtis Framel, Seattle RO, at Energy 2000.

Web Tools

Look for Portfolio Manager on the Web

ENERGY STAR® Upgrading Building Performance Rating System

Soon you'll notice a change. A change for the better. For those who are interested in whole-building benchmarks, ENERGY STAR® will soon launch an upgraded version of the online benchmarking tool, which will now be called portfolio manager. This is an exciting new enhancement from ENERGY STAR® that will now allow organizations to measure and track energy performance improvements, make the best possible upgrade decisions, and earn the ENERGY STAR® on qualified properties.

Portfolio manager's features will enable you to:

- Benchmark and label your buildings;
- Track your buildings' energy and space use over time, set performance targets, and monitor your success;
- Compare buildings in your portfolio and set priorities for investing in and rewarding improved performance;
- Track energy use and benchmark improvement over time, both for individual buildings and for your total portfolio; and
- Make quick, first cut portfolio benchmarking easier.

The ENERGY STAR® performance rating system will be unavailable while the transition to portfolio manager is taking place. The new system will be online by the end of October. Check back with ENERGY STAR® at www.epa.gov/buildings.

For more information, contact Michael Segal at 703-247-6113 or msegal@cadmusgroup.com.

Visit FEMP's Training Event Locator System

Please remember to take advantage of FEMP's Training Event Locator System, LOCATOR, now available on the Web at www.eren.doe.gov/femp/resources/training/locator.html. This database of energy management training courses can help to efficiently find a training course or conference offered by organizations other than FEMP. These organizations include government entities, colleges and universities, professional associations, industry groups, and private-sector organizations. LOCATOR is designed for operations staff, designers, managers, planners and acquisition personnel at Federal facilities to help improve their energy-saving capabilities.

LOCATOR provides training course information including:

- Course Category and Course Sub-Categories,
- Course Title,
- Event Dates and Location,
- Organization Contact Information,
- Course Cost,
- Target Audience Information,
- Continuing Education Units (CEUs), and
- Other information as appropriate.

LOCATOR's specialized search features will find the courses that energy managers need. It is a convenient and easy way for energy managers and personnel to research the appropriate training they need to meet their energy saving goals. If you are interested in saving energy and time, please take a moment to visit LOCATOR on the Web.

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systems the school district could have installed. The study's cost analysis methods and meticulous study of extensive data are described in the report, which concludes that the GHPs are the most life cycle cost effective HVAC option for the schools. This research is relevant to GHP projects generally, but especially to Federal projects in educational facilities or other buildings with load patterns similar to those in schools.

Construction- and Maintenance-Cost Database

Estimating the costs of installing and maintaining HVAC systems is a fundamental part of the HVAC business. Unfortunately, the standard tools for estimating these costs have not yet been established for GHP systems. In fact, reliable data to document GHP system costs have never been compiled in usable form, and GHP systems are left out of mainstream cost estimating sources. The GHP Core Team is establishing a database of construction costs and annual maintenance costs from actual GHP projects to fill this need. The team is working closely with the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) on this database, which is expected to become the basis for ASHRAE's new cost estimating documents. If you would like more information or can provide data sets, see the on-line survey and database at http://public.ornl.gov/btc_mic/logon.cfm.

GHP Core team contacts are Patrick Hughes at 865-574-9337, hughespj1@ornl.gov; John Shonder at 865-574-2015, shonderja@ornl.gov; Michaela Martin 865-574-8688, martinma@ornl.gov; and Warren Thomas at 865-576-6309, thomaswk@ornl.gov.

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and other emerging technologies are currently under consideration, and may be incorporated in the construction of the remaining five entrance stations planned for Lake Mead NRA. Additional partners such as the Nevada State Energy Office may participate in the next phase of this project.

For more information, please contact Steve Butterworth, National Park Service at 206-220 4277.

Project Partners (left to right) Tim Scanlon (BPA), Jim Vanderford (LAME), Steve Butterworth (NPS), Superintendent Alan O'Neill (LAME), Bill Dickinson (LAME), and Curtis Framel (DOE).

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installation will add to our ability to serve postal customers well throughout the great state of Alaska, and also help us safeguard its unique environment.

"We are proud to partner with the various governmental agencies and businesses involved, and with Senator Stevens in delivering this successful and environmentally beneficial fuel cell project," the postmaster general added.

"I applaud Chugach Electric for its efforts in this fuel cell project and the Postal Service for its continued commitment to serving Alaska," Senator Ted Stevens said of the fuel cell. He went on to note, "The Postal Service's leadership and experience in connecting all Alaska communities, and Chugach Electric's continued dedication and innovation in providing energy to Alaskans, are stronger through this project."

Senator Stevens added: "This fuel cell project, and the benefits it brings to our state, opens the door to new and creative ways to produce energy in a cost effective and clean manner. I hope others will look into using this power source as a building block for future energy needs in Alaska and I congratulate Chugach Electric and the Postal Service on this successful venture."

New technology, developed for the project and largely funded by the DOD, Army Corps of Engineers, Construction Engineering and Research Laboratories (CERL), assures that the facility will continue to operate uninterrupted during a grid outage. If there is a grid outage, the fuel cells transition to operate as an independent system, continuing to power the Postal Service facility. The automatic transition will appear seamless, eliminating the need for conventional non-interruptible power supplies and stand-by generators.

Heat recovery from the fuel cells will help provide space heating to the facility, increasing the overall fuel efficiency of the Postal Service Center. As a result, less fuel will be needed than from conventional systems.

Fuel cells do not burn fuel so the system eliminates air emissions normally associated with acid rain and smog, and dramatically reduces those associated with global warming. Compared with electricity generated from the average combustion-based processes in the Lower 48, a one-megawatt fuel cell system would save more than 200,000 pounds of air pollution and 11 million pounds of carbon dioxide from the atmosphere during each year of operation.

Research, development, manufacture, and installation of the approximately $5.5 million fuel cell system was funded, in part, by Chugach, the U. S. Postal Service, U. S. Department of Defense, Cooperative Research Network of the National Rural Electric Cooperative Association, and the Electric Power Research Institute. The control system for the project was developed and funded by the DOD, U.S. Army Corps of Engineers, and CERL.

"This project helps position Chugach in the emerging competitive electric utility industry," said Eugene Bjornstad, General Manager of Chugach. "Fuel cells allow us to offer customers options."

"This project is another example of how our fuel cells can serve the commercial power market," said William T. Miller, IFC President. "We are especially pleased to showcase the assured-power capability for a highly visible customer like the Postal Service."

Installation of fuel cells doesn't stop in bad weather. Chugach was prepared for the snow to hit and used that as another reason for choosing such a large installation area, an advantage of which is low snow removal maintenance costs.

FEMP Contacts

FEMP Help Desk	800-363-3732
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LBNL: Lawrence Berkeley National Laboratory
NREL: National Renewable Energy Laboratory
ORNL: Oak Ridge National Laboratory
PNNL: Pacific Northwest National Laboratory
SNL: Sandia National Laboratories

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